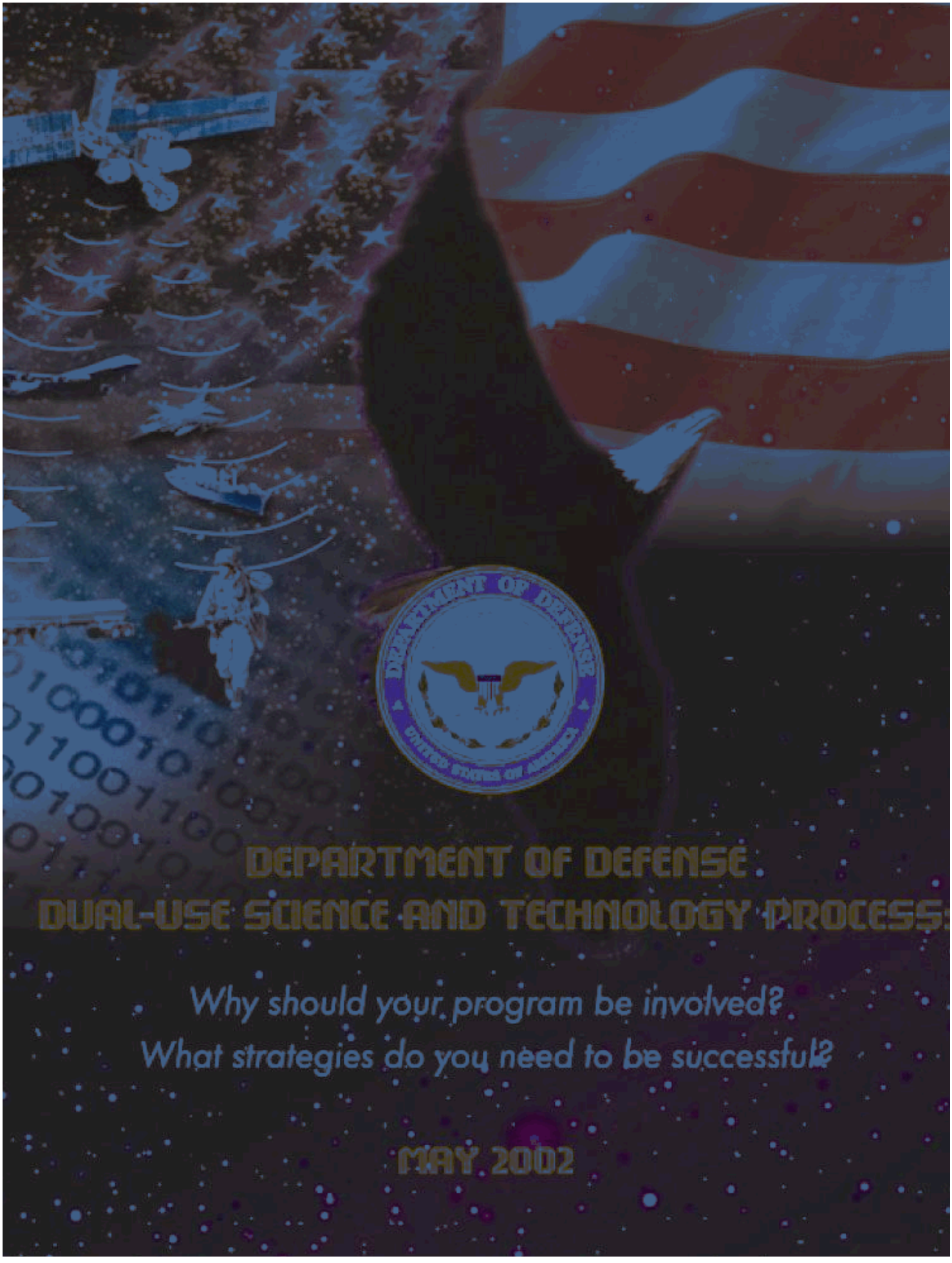

DEPARTMENT OF DEFENSE DUAL-USE SCIENCE AND TECHNOLOGY PROCESS:

Why should your program be involved?
What strategies do you need to be successful?

MAY 2002

DEPARTMENT OF DEFENSE

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Introduction

ABOUT THIS GUIDE

The primary intent of this guide is to empower you to initiate dual-use science and technology (S&T) development projects with industry to meet future defense technology needs. The term "dual-use S&T" refers to technology that has utility both on the battlefield and in the commercial marketplace. Dual-use development involves industry cost sharing and the use of innovative mechanisms to provide the flexibility needed to attract commercial firms and form "win-win" partnerships. Through such partnerships, technology that meets the needs of both the battlefield and the commercial marketplace can be developed. Increasing dual-use or commercial technologies in defense systems can result in both economic and performance benefits. There are three ways to do this, two of which involve technology transfer. Either a military technology can be transitioned from the military to the commercial world and successfully incorporated into commercial products, or a commercial technology can be adapted and incorporated into a military system. The third approach is for the military and industry to jointly develop a dual-use technology that currently does not exist. Joint development provides early access to important technologies and leverages scarce S&T funds. This third approach is the focus of this guide.

Department of Defense (DoD) programs to develop dual-use technologies with industry have existed since the early 1990s. One of the first of such programs was the Technology Reinvestment Project (TRP)[1] followed by the Dual Use S&T Program.[2] These programs pioneered the concept of collaborating with industry to develop dual-use technologies. More than 500 dual-use projects have been initiated under these programs, with mixed levels of success. This guide presents information gained from these programs and offers an approach to successful development of dual-use technologies with industry. The approaches presented in this guide should not be viewed as one-size-fits-all. Rather, the techniques herein should be customized to fit your own circumstances. The means are not as important as the result—a jointly developed technology that transitions to military systems as well as commercial uses. The full impact of dual-use S&T development and the increased use of dual-use technology will not be felt immediately. However, a long-term measure of success will be whether dual-use S&T development becomes an option in our normal way of doing business. This guide provides the instruments needed to make that happen.

[1] TRP Defense Conversion, Reinvestment, and Transition Assistance Act of 1992.

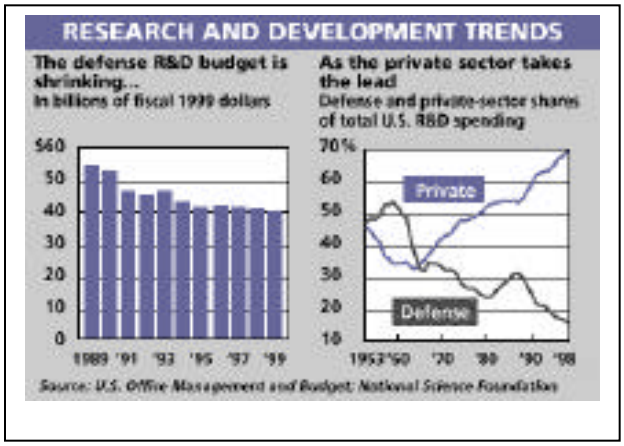
[2] The term 'dual-use project' means a project under a program of a military department or a defense agency under which research or development of a dual-use technology is carried out and the costs of which are shared by the Department of Defense and nongovernmental entities. A website has been established for the DoD's Dual Use S&T Program at www.dtic.mil/dust.

The technology development strategies discussed in this guide are appropriate for acquisition and assistance funding instruments. Acquisition instruments are contractual mechanisms used to purchase goods and services for the direct benefit of the government, while the objective of assistance instruments is to stimulate or support technology development because the technology can also be used to meet defense needs. Discussions of technology development in this guide could relate to either acquisition or assistance instruments.

WHY SHOULD YOU CONSIDER DUAL-USE TECHNOLOGIES WITH INDUSTRY?

The goal of the DoD's S&T program is to provide the best technology available to our warfighter. In the past, we met this challenge by calling on a host of in-house laboratory capabilities, as well as a U.S. industry that was familiar and willing to work with the military to develop the technologies it needed. The government had access to the best private laboratories (university and industry) and was arguably the dominant source of funds for cutting-edge research. Government investment led the way in many important technological areas, which often resulted in significant technology spin-offs to the commercial sector. That defense/industry research and development (R&D) relationship has fundamentally changed. While government R&D investment remains important, commercial investment is much more dominant today and continues to grow—especially in microelectronics, software development, biotechnology, photonics, and wireless communications.

Budget pressures have squeezed military R&D spending in recent years…down 30% from its inflation-adjusted peak in 1989. Meanwhile, the private sector's share of total R&D expenditures in the U.S. is soaring. In 1960, private sector R&D spending amounted to roughly one-third of the country's total. In 1999, it accounted for two thirds (an estimated $166 billion). Over the same period, the military's share dropped to 16% from 53%.[3]



As measured by resources and share of R&D, the graphs in Figure 1 show that technology leadership has shifted to the private sector, where most R&D dollars are being spent to meet the demands of the commercial marketplace. These investments have the potential to meet the department's needs in such areas as information technologies, microelectronics, and materials sciences. However, the department

[3] Chen, Kathy, "Pentagon Finds Fewer Want to Do Military R&D," *Wall Street Journal*, 12 November 1999, sec. A, p. 20.

does not have ready access to many technological advances in these areas because the commercial firms developing them can be reluctant to do business with the DoD.

A number of obstacles continue to inhibit commercial firms from collaborating with the DoD. These obstacles include concerns over intellectual property (IP) rights and data, government cost principles (including Cost Accounting Standards [CAS]), audits, and foreign access to technologies. The dual-use process described in this guide can serve as a starting point to overcome these obstacles, form effective partnerships with industry, and gain increased access to necessary commercial technologies.

The goal of dual-use technology development should be the creation of a commercial product that also meets future military needs. This goal is much more likely to be met if there is early involvement in the product's design and development process to ensure incorporation of unique defense interests. For most commercial markets, it is customary for product developers to reach out to their potential markets in the preliminary stages of development to identify and understand their needs. However, commercial developers have limited knowledge of defense mission needs. Collaborating early in a product's development cycle helps industry more accurately understand the product's potential military use. Identifying appropriate dual-use opportunities and working with industry to overcome obstacles to joint development are essential first steps in the dual use technology development process.

A common argument against initiating dual-use technology projects is that "funds are tight and we must use our available funds to develop critical defense technologies." Yet, where there is commercial potential, what better way is there to expend your funds than to cost share with industry to meet some of your technology needs? Cost sharing on dual-use technologies can help to expand funds for other critical technologies that may not be appropriate for dual-use development.

Another common argument is that "dual-use S&T is great, but I make missiles and there are no commercial applications for missiles." Of course it is true that there are no commercial applications for missiles per se, but what about all of the components and materials that are incorporated in them? Although the end product may not have direct commercial applications, its components and materials likely do. The key is to identify where it makes sense to work with industry to develop component technologies that will meet dual requirements. Not only will you save valuable resources through cost sharing, but the potential commercial demand should drive the cost of dual-use components or materials down over time, resulting in further savings during systems acquisition and reduced total ownership costs.

Identifying Dual-Use Science and Technology Opportunities

> It is DoD policy to give preference to the initiation of a dual-use project to satisfy user requirements. DoD Directive 5000.1 states "In general, decision-makers, users, and program managers shall first consider the procurement of commercially available products, services, and technologies, *or the development of dual-use technologies*, to satisfy future user needs, and shall work together to modify requirements, whenever feasible, to facilitate such procurements." (emphasis added)

Dual-use technology development is not appropriate in all instances. Some technologies are, and should be, defense unique. Other technologies provide no business case (e.g., sufficient return on investment) to justify the dedication of commercial resources. Before you initiate a dual-use project, be sure the technology you want to develop is truly a dual-use technology. Simply considering whether the technology has commercial potential is not enough. Virtually any technology could have some commercial potential. Rather, you must determine whether the technology has sufficient commercial potential to:

- Attract commercial investment in its development, and
- Support a viable production base that does not rely on defense requirements.

> An underlying principle of dual-use S&T development is the establishment of a "win/win" partnership between the DoD and industry.

A key step in determining a technology's potential for dual use is to identify its applicability and benefits for both parties. DoD benefits can include:

- Access to the technologies of commercial firms,
- Incorporation of defense needs into commercial products,
- Leverage of scarce S&T funds,
- Reduced acquisition costs due to the economies of scale in the commercial market,
- Worldwide maintenance and supply support, and
- Access to future technological advances driven by the marketplace.

Industry benefits can include:

- Leverage of industry's corporate S&T funds with DoD cost sharing,
- Increased markets (foreign and domestic),
- Access to DoD technology and capabilities,
- A new partner with many resources, and
- Access to unique testing environments

Appendix A presents dual-use project success stories that discuss specific programs in which these benefits have been manifested.

Basic Concepts of Dual-Use Science and Technology Development

Several basic concepts underlie dual-use S&T development. These include the flexible and cooperative nature of the working relationship between the parties, the sharing of the cost of development, and the need to have military as well as commercial uses for the technology developed. Each of these concepts is discussed below.

THE WORKING RELATIONSHIP: COOPERATION IS ESSENTIAL

Dual-use S&T projects tend to be quite different from conventional S&T projects. First, the nature of the relationship between the DoD/Service program manager and industry is fundamentally different in a dual-use project. You are not in the traditional relationship you have likely experienced under conventional projects. Instead, you and the other parties are joint investors—partners. You will have to focus your leadership skills on cooperating with your partners to achieve the mutually-agreed-upon outcomes of the project. Because this flexible mindset is crucial to managing such projects successfully, keep the following operating principles in mind:

- Be open to dual-use opportunities and be flexible enough to modify your initial goals and objectives to take advantage of commercial technology investment and dual-use S&T opportunities that may address long-term military needs.

- Also, be flexible in negotiations with industry prior to the start of the project and during its execution. Be willing to accommodate your partners' interests as long as they are not in conflict with government interests. Being an acceptable partner often means setting aside many of the conventional practices that could hinder negotiations with commercial firms, e.g., requiring unnecessary project documentation or excessive intellectual property rights.

The government pursuit of S&T technology development, under traditional approaches, involves a business relationship that normally obligates the government to pay the costs of development. As the "sole investor," the government expects to be given license to the IP developed under the funding instrument. In contrast, partnerships for dual-use S&T development involve different obligations and expected outcomes. With a dual-use project, the government and industry seek to share both the costs based on the perceived risks and the expected future benefit

to each party. As a result, the government does not pay the entire R&D cost, nor should it expect to reap all of the technology rewards. Instead, for example, the government may enter arrangements in which it receives limited or no rights in technical data or computer software (intellectual property). The government/industry relationship should be determined by what each party is contributing to the success of the project and by what is required of each partner in the particular circumstance.

In cost-sharing arrangements, the firms must demonstrate a clear commitment to share the development cost and risks.

COST SHARING

Cost sharing is a fundamental aspect of dual-use technology development projects. Through cost sharing, industry incurs financial and technical risk, thus demonstrating real commitment to the project's success. The percentage of each party's cost share may vary according to anticipated risks and benefits, as well as each party's financial resources. For example, small firms typically have fewer available resources than large firms.

The original TRP statute required at least 50 percent cost share by industry on all projects. In some cases, this fixed requirement precluded participation of small firms that might have had interesting technology to contribute to a project. In other cases, the requirement failed to adequately portray the real benefit/risk relationship existing between the government and its commercial partners. While we should strive to achieve at least 50 percent cost share, flexibility in industry's investment level is needed if dual-use S&T development is going to achieve its full potential. Generally, the industry cost share should range from 25 to 75 percent of development costs.

On May 16, 2001, the Under Secretary of Defense for Acquisition, Technology, and Logistics signed a memorandum concerning contractor cost share. The intent of the memorandum was to limit the amount of cost share required from contractors under procurement contracts.[4] However, the memorandum clearly states, "the only exception to this policy would be unusual situations where there is a reasonable probability of a potential commercial application related to a research and development effort." Clearly dual-use technology development falls under this exception.

MILITARY AND COMMERCIAL UTILITY

Any technology considered for a dual-use S&T project must have, by definition, both military and commercial utility. A dual-use S&T project should not be employed to develop a technology for purely military use; nor should the DoD fund a dual-use S&T effort that is purely commercial and has no identified military ap-

[4] Procurement contracts in this document refer to FAR-based contracts.

plication. It is critical to have a good plan for transitioning the technology into both military and commercial products. On the military side, this includes transition into either a development program or an existing system. On the commercial side, this means ensuring the technology has viable commercial potential.

As stated, the dual-use technology must have obvious military use and provide sufficient expected military benefit to warrant DoD investment. Benefits can be measured in terms of improved performance, reduced development or life-cycle costs, reduced development times, and/or improved safety. The project team should be working with potential military users early in the process to ensure that the technology will adequately address their needs. Early involvement also aids in the development of a transition strategy for the technology. The transition strategy should take into account such issues as adequate scheduling, testing, and training; as well as environmental constraints.

A viable commercial market potential must exist in order for the government to obtain cost share from industry and reap maximum benefits in the military procurement phase. The industry partners will determine commercial markets, but these markets should be apparent to the government partner as well. Since commercial business usually has a shorter product development cycle than the government, commercial products might be expected to precede the introduction of defense products. It is important to determine during proposal evaluation whether the technology has sufficient commercial potential and the industry partners have the necessary qualifications to commercialize the technology.

> The technology selected for dual-use development must also have viable commercial potential.

Working Under the Dual-Use Paradigm

AREAS OF MUTUAL INTEREST

The first step necessary in establishing dual-use technology projects is to identify areas of mutual interest with industry that can lead to the development of "win-win" partnerships. One approach used by the Dual Use S&T Program to identify areas of mutual interest was to identify broad technology thrusts,[5] e.g., diesel engines, radios, and integrated circuits. Once a technology thrust is identified, a group of firms (both defense and commercial) that are involved in the technology are selected to help develop specific topics that support mutual goals. An alternative approach is to invite all potential partners to a workshop to identify topics. Once identified, these topics can be included in a Broad Area Announcement (BAA) or similar program solicitation that requests proposals from industry.

A number of databases are available to sort firms by technology areas. Further, most industry associations are willing to help. When advertising, remember that most commercial firms do not use the Commerce Business Daily or the Federal Business Opportunities website, so advertise in publications that will reach commercial firms, e.g., industry publications or trade journals, and/or national newspapers or magazines. In addition to classic market research techniques, word of mouth or contacting potential candidates should give you good leads on specific firms that are working in the technology area(s) of interest and might be willing to partner with the DoD to develop a dual-use technology.

Whatever method is used, identify specific topics or areas of interest with industry before releasing a solicitation. There are three primary advantages to this approach. First, there is a better chance of identifying topics or projects that are truly dual use. Second, it will target a relevant group of firms. Third, there will be early buy-in and ownership from firms, which should result in better proposals and the formation of a more effective partnership.

Even if there is a potential partnering opportunity, weigh whether this is the right time for a dual-use effort. For example, on one hand, the commercial application may be too far in the future for commercial providers to be willing to make an investment with their own funds. On the other hand, the military use might be too far off, making it best for the Department to "wait and see." In some cases there may be commercial technology development whose momentum is so strong, well-directed, and on-target with military needs that it may pay to do nothing and simply wait for the desired products/processes to emerge through natural marketplace forces.

[5] A *technology thrust* is a technology sector where potential commercial and military applications exist.

Open dialog with industry before and after the issuance of the solicitation is encouraged. This dialog is a valuable tool that should be used to help industry prepare a proposal that addresses the needs of the government and industry.

It is important to maintain competition during the topic development process to ensure fairness and access to the best ideas. Fairness requires that potential offerors do not have to participate in the topic development process in order to submit a proposal. Further, offerors who do participate in the topic development process must not be given information that could result in a competitive advantage or receive preferential treatment during the evaluation of proposals.

INDUSTRY VERSUS DOD FOCUS

Industry has different incentives for technology development than the DoD. These differences affect not only the motivations for dual-use S&T development (and willingness to participate in the process), but also the nature and speed of the research process itself. Firms must successfully develop technology to be competitive and stay in business. They will not undertake a dual-use S&T development project unless they believe it will produce technology that can be applied to their products and provide them a competitive advantage in the marketplace. Their owners/stockholders require them to be profitable. Subsequently, decisions about what technology to pursue and how to use that technology will be based on maintaining their competitive advantage. Further, they will want to closely guard the technology developed because it is what will make them competitive in the marketplace. These issues need to be addressed and dealt with for your dual-use project to be successful.

Defense firms generally have organized their R&D and business activities to conform to the government business process. Commercial firms have not, and are unlikely to do so. In most cases, the potential government market is too small to provide an incentive for a firm to reorganize to conform to government-unique requirements, and such reorganization could reduce the firm's competitiveness in the commercial marketplace. It is important to be aware of and understand the market-driven pressures commercial firms face and the differences between defense firms and commercial firms as you develop cooperative project plans, seek qualified partners, and negotiate agreements.

Seeking Potential Partners

To achieve its S&T objectives, DoD must partner with a wide range of organizations that have access to technologies. Potential partners include commercial firms, defense firms, not-for-profit organizations, colleges and universities, and other government agencies. While we often focus on attracting commercial firms, we should not lose sight of defense firms' importance in the process because they are often needed to integrate the technology into military systems. Their knowledge is indispensable.

COMMERCIAL FIRMS

Commercial firms or commercial business units of defense firms are defined as those whose principal sales are to the commercial market rather than to the defense market. The Dual Use S&T Program defined them as firms whose sales to the DoD have averaged less than 30 percent of their total sales over the past five years. However, such sales data often are difficult to obtain. For the purpose of achieving the DoD's S&T objectives, consider as commercial those firms or business units whose sales are principally nongovernment and that have not organized specifically to do business with the government. As has been stated, partnering with commercial firms can provide access to technologies that otherwise would not be available to the DoD. It can also result in savings during the procurement phase, when the government's purchase price should be reduced due to the larger market base.

The motivations for commercial firms to participate in dual-use S&T development include the need for additional R&D funding; the potential access to the government market; and the potential access to government technology, expertise, and facilities. However, significant differences in these firms' motivation and ability to participate in a dual-use project exist because of variations in their size, market segment, and profitability. These differences must be considered when developing a project idea, looking for potential commercial partners, and negotiating dual-use S&T project agreements.

DEFENSE FIRMS

Defense firms are firms that are experienced in working with the DoD and have the business structure (e.g., government-compliant accounting processes) to negotiate and accept cost-based funding instruments, i.e., cost-based FAR contracts, and cost-type assistance instruments.

When working with defense firms it is important to have a good understanding of how the technology is going to be commercialized. Defense firms can directly

enter the commercial market with the developed technology, but their past success in doing so has been limited. A successful model would be when a defense firm teams with a commercial firm to develop a technology that can transition respectively to defense systems and the commercial market. This model can also be successful when the defense firm teams with commercial business units within its own corporation. These cases combine a commercial firm's technological capability with a defense firm's understanding of the military environment and its operations.

> Defense firms play an important role in dual-use S&T projects because their understanding of military needs enhances the technology's transition to defense systems.

The same innovative funding instruments can be utilized for dual-use S&T projects with defense firms as with commercial firms to address unusual IP concerns. When partnering with defense firms, IR&D funding should be considered a legitimate form of cost share. Just like their commercial counterparts, defense firms make IR&D investment decisions and have total discretion over where to use its IR&D funds. And, just as in a commercial setting, the defense firm determines which projects will provide the greatest return in terms of potential market share, in order to ensure the firm's continued survival. It is important to recognize that these IR&D funds are part of the cost of doing business, they affect an industry partner's competitive position, and should be considered a legitimate portion of a defense firm's cost share.

OTHER POTENTIAL PARTNERS

Other organizations that may be interested in participating in dual-use S&T development projects include:

- Educational institutions may be conducting basic research and may have developed some of the technology in the proposed project. For example, university research centers concentrating on problems related to internet, combustion engines, rotorcraft, and other specialties have been very active in dual-use S&T development projects.

- Other nonprofit organizations often have research expertise and can be a valuable part of the team.

- Other government departments and agencies, federal or nonfederal, such as the National Aeronautics and Space Administration (NASA), the Department of Energy and state governments, might be attracted to projects of interest to the military services and might add funding as well as expertise to the project.

When working with potential partners like these, it is important to closely examine the project team to be sure the right people are in place to both commercialize the technology and transition it into a defense system(s). Ask how these goals will

be accomplished and who will make it happen. If the answers to these questions are unclear, do not proceed until you are satisfied that the project team has the resources needed to successfully develop and transition the technology into defense systems, and commercialize the technology.

DEALING WITH CONSORTIA OR INDIVIDUAL FIRMS

Dual-use S&T development agreements can be made between the DoD and a single for-profit firm, *or* a team consisting of one or more for-profit firms that also can include nonprofit firms, educational institutions, or other federal or non-federal government agencies (consortium). Industry teaming can provide an essential combination of expertise that may not exist in a single firm. For example, as previously discussed, teaming between a defense firm and commercial firm makes both military and commercial product success more likely. Teaming among the nongovernment partners can take the form of several business arrangements, such as a strategic alliance, pre-competitive partnership,[6] industry co-funded research consortium, or a subcontracting relationship. The actual nature of the relationship among the nongovernment participants should be determined among themselves. Critical to the success of the partnership is your understanding of certain elements related to the team membership and the relationships among those members.

Team Members

Studies[7] have identified "partner selection" as the most important element for collaborative project success. Other critical elements cited by the studies are:

- Commitment from senior management,
- Clearly understood roles,
- Communication between partners,
- Clearly defined objectives, and
- Relationship building.

Your selection of partners or team members is critical to the success of a collaboration or multi-party relationship.

If you are working with a multi-party agreement such as a consortium, remember that each team is unique with a unique set of relationships. The umbrella team relationship depends on many factors, such as market forces, competition (domestic

[6] A *pre-competitive* partnership is one where several different companies have a similar technology challenge and pool their resources to solve it.

[7] In 1992, Data Quest published a survey of chief executive officers representing 455 electronics companies. In 1995, the Institute for Defense Analyses (IDA) studied research projects conducted under the "other transaction" authority of the Defense Advanced Research Projects Agency. Publication information on these studies is provided in IDA Document D-1793, dated November 1995.

and/or foreign), business strategies, and the resources that individual team members bring to the project.

Team formation and getting the right "mix" of partners are critical because business relationships usually flow naturally from commonality of purpose and a shared vision. If partnerships are forced rather than carefully selected, you might anticipate more conflict, which could become problematic.

The Team Relationship

Working with a consortium produces a variety of advantages. Three specific teaming advantages to the government are:

- Technical insight, and enhanced visibility into research performed by all members of the team;
- Effective leverage of government resources, resulting in risk reduction; and
- "Decreased oversight requirements," (i.e., technical progress reporting) which has the potential for cost reduction.

One of the more frequently heard criticisms of the traditional prime awardee/subawardee(s) relationship is the lack of visibility into the research work at levels beneath the prime. Unlike the traditional awardee/subawardee relationship, members in a consortium (regardless of business size) can have equal standing within the team (in accordance with the consortium agreements) and, more importantly, with the government. When a dual-use S&T development agreement consists of a consortium relationship, the clear advantage to you—the government technical program manager—is the visibility of all research being performed. This level of research awareness strengthens the impact of your advice and guidance during the project.

Since an individual member's success generally is dependent on the success of every other participant in the team, a "self-policing" mechanism comes into play. This is particularly evident when members are investing their own money and are competitors. Multi-party dual-use S&T development agreements are characterized by self-interested members, and it is this self-interest and the reduced government share of the total investment that result in a decreased need for government oversight in maintaining the public trust.

Your role in the team or consortium decision-making will vary from one project to another. In some cases, it may be appropriate to be a full member of the consortium's decision-making body, with voting rights equal to those of the other members. In other cases, you may participate in consortium decisions as an observer, with input into deliberations but no vote. It usually will be inappropriate for the government to be able to veto a consortium decision. Keep in mind, how-

ever, that dispute procedures may be invoked or the agreement terminated should the consortium choose a direction that does not appear to be serving the government's interests.

Establishing the Relationship

Multi-party relationships add complexity to any negotiation process. To further complicate things, there is more than one relationship-building process going on simultaneously: the individual consortium members are building relationships with one another, and the industry and other non-government participants are building a relationship with the government.

> The key to team formation lies in the relationship-building process.

The emphasis in dual-use S&T development projects is on establishing and managing collaborative relationships. However, operating in a teaming environment is not something that comes naturally or easily. Therefore, the relationship-building process should begin prior to solicitation and should continue after the project term has ended. Getting all participants to focus on and understanding the nature of this relationship-building process, the power it holds when properly utilized, and the flexibility it requires, is a very important part of doing business in a new way.

A first step in building a relationship is making sure all parties understand the scope of the project and why the parties are consenting to work together. The only way to fully address the parties' common understanding of what their joint effort is all about, is to develop a "vision statement". To come to a common understanding, the parties should discuss and answer questions such as:

- What is each party's expectation for the successful outcome of the effort?
- What are each party's goals—individual and joint—for the project?
- What is the nature of the research effort involved?
- What are the parties' obligations to each other?
- What are the prospects for both military and commercial benefits?
- If costs are to be shared, what will be the arrangement and its underlying rationale?

"Articles of Collaboration"

Unclear expectations give rise to ambiguities, which in turn foster anxieties and lack of trust among nongovernment and government participants. Perhaps the single most useful instrument to resolve these issues is a documented set of rules and procedures that govern the activities and relationships of the non-government

participants. This document is sometimes called the "Articles of Collaboration" and can help address issues involving proprietary data, licensing agreements, program management, administration, disbursement of payments to members, and property disposition. A sample "Articles of Collaboration" can be found on the Dual Use S&T Program's website at www.dtic.mil/dust. If there are any "showstoppers," they will be unveiled as the members begin to articulate their various positions on these issues.

All of this takes time, and one criticism of dual-use S&T development agreements is that negotiations take too long. While it is true that dual-use agreements can take longer to negotiate than other Federal awards, it is time well spent and will greatly increase the likelihood of project success and technology transition. One lesson learned is to encourage firms to begin working the "Articles of Collaboration" as soon as practicable to minimize delays and surface issues among participants early.

NATIONAL COOPERATIVE RESEARCH AND PRODUCTION ACT

One issue that has recurred in discussions of multi-party relationships for research has been the possible anticompetitive nature of the arrangement. Under certain circumstances, joint research activities might be considered anticompetitive (presumably the parties to the research hope it will provide them with a competitive advantage, or they would not undertake it in the first place). A joint venture, for the purposes of the National Cooperative Research and Production Act of 1993,[8] is two or more persons undertaking certain defined activities. Consortia entering into dual-use S&T development agreements often will fall within this definition. The fact that the government is a party to the agreement provides little or no protection from anti-trust allegations. Thus, participants in a dual-use project that have collaborated in the form of a consortium might have anti-trust concerns.

However, the National Cooperative Research and Production Act provides some anti-trust protection for joint research ventures and certain joint activities involving the sale of products or services. Consortia or partnerships may want to take advantage of the statute, which supplies a "rule of reason" standard, limits damage awards to actual damages, and provides certain other protection, by filing with the Department of Justice and making public notification. Whether a consortium wishes to take this action is entirely its own decision, in which the government has no role other than to advise participants that it has no objection to such action.

[8] Codified at 15 U.S.C. 4301-4306.

Dual-Use Projects With Single Firms

The majority of dual-use agreements have been comprised of multiple participants. However, many successful dual-use agreements have had only one industry member. These single-industry dual-use agreements offer many of the same benefits as multi-party dual-use agreements and have attracted some of the biggest high-technology firms in the United States that had not previously engaged in standard research instruments with the government, e.g., Cray Research Inc., Intel Corporation, Hewlett Packard, Oracle, and Microsoft. However, since these agreements are with single firms, many of the agreements' self-policing aspects (e.g., financial and technical insight by other industry partners) are not valid. Instead, the team arrangement between an individual firm and the government requires the government to be a more active participant as a teammate, in order to ensure appropriate insight. Under single-firm dual-use agreements, you will need this insight to assist the firm's successful participation in the project and to ensure adequate monitoring of progress. These activities are far different from those involved in traditional S&T projects.

CHALLENGES DEALING WITH COMMERCIAL FIRMS

It is important to remember that, in most cases, we need commercial firms much more than they need us, so we should not expect them to beat a path to our door looking for opportunities to collaborate with the government. If we want access to their technology, it is going to be up to us to identify potential opportunities and partners, and to work with them to develop partnerships that are mutually beneficial.

One way to foster interest from commercial firms is to keep the solicitation and negotiation process as simple as possible and remain flexible to accommodate their concerns. These concerns tend to focus, for the most part, on the areas addressed below.

Intellectual Property Rights

Private firms view their IP as their crown jewels and go to great lengths to guard their rights in patents, trade secrets, copyrights, and trademarks. Because small firms may have few or only one technology as their IP basis, they will be especially concerned about protecting their rights. Government cost share and potential government markets provide some incentives to participate in a dual-use S&T development program, but only if the participating firm's critical rights in IP are not jeopardized.

> No firm will knowingly risk what it considers very valuable commercial technology in a development program with the government without agreed-to protections or provisions.

The question to consider is "what rights does the government really need to ensure that the technology can be used to meet future defense require-

ments?" Balance the government's need for rights to the technology with the opportunities to:

- Gain access to the commercial technology in the first place,
- Incorporate defense requirements into a commercial technology, and
- Obtain future performance enhancements and life-cycle-costs savings that may result from the commercialization of the technology.

Case studies of dual-use agreements reveal that commercial firms are reluctant participants in any technology development effort where they cannot control, or at least freely apply, the technology subsequent to the completion of the joint research project. Agreement provisions that provide government-use rights or the potential compulsory license of the firm's technology to another entity (even if the probability of such licensing is low) can strongly deter a firm from entering into a dual-use agreement with the government.

The good news is dual-use agreements can provide the flexibility needed to negotiate a balance that suits both parties. For example, industry might retain all of its rights in IP as long as the technology was deployed into commercial products in a reasonable time. You must consider the risks and rewards of IP licensing when dealing with this concern. An IP guide, developed by the Under Secretary of Defense (Acquisition Reform), titled "Intellectual Property: Navigating through Commercial Waters" can be a helpful resource for guiding your decisions. You can find this guide on the Acquisition Reform Web page at http://www.acq.osd.mil/ar/.

It is important to resolve IP-right issues early in the negotiations. IP issues can result in a company deciding not to participate. To avoid major program disruptions it is best to identify any potential show stoppers as early as possible. When negotiating IP be flexible and follow these principles:

- Integrate IP considerations fully into acquisition strategies for advanced technologies in order to protect core DoD interests.
- Respect and protect privately-developed IP, because it is a valuable form of intangible property that is critical to the financial strength of a business.
- Resolve issues before award by clearly identifying and distinguishing the IP deliverables from the license rights in those deliverables.
- Negotiate specialized IP provisions whenever the customary deliverables or standard license rights do not adequately balance the interests of the firm and the government.

- Seek flexible and creative solutions to IP issues, focusing on acquiring only those deliverables and license rights necessary to accomplish the acquisition strategy.

Cost Accounting and Auditing

In general, commercial firms do not have cost accounting systems that comply with government-developed cost principles, nor are such firms normally willing to accept government-performed audits. Large commercial firms generally have more fully developed accounting systems than do smaller firms. You will need to be especially aware of the potential internal cost accounting limitations of commercial firms and be prepared to work with them to develop a system of checks and balances that is acceptable to both parties.

Fortunately, dual-use agreements also help to solve this problem. Under dual-use agreements, commercial firms can generally use their existing financial management system as long as it complies with Generally Accepted Accounting Principles. In addition, if the commercial firm is not now subject to Defense Contract Audit Agency audits, it may use its independent auditors to audit the project.

Foreign Access to Technology

A third area of concern deals with restrictions placed on foreign access to the technology being developed. Generally, firms understand the requirements of the Export Administration Act of 1979[9] and seek to comply with it. However, they tend to avoid developing a technology subject to the International Traffic in Arms Regulations (ITAR)[10] because of the additional international business restrictions. Be aware of such industry concerns and avoid adding requirements over and above those in existing statues. Defense firms must also comply with the DoD Industrial Security Regulation in DoD Directive 5220.22-R.

Consistent with the objective of increased DoD reliance on U.S. commercial technology and industrial bases, dual-use agreements may include a Foreign Access to Technology provision. This provision necessitates, as a minimum, that the recipient obtain government approval before it provides an exclusive license to a foreign firm for the manufacture of products resulting from the research.

A balance must be established. On one hand, consider the desirability of a domestic source for a critical defense technology. On the other hand, if this issue causes a firm to decide not to enter into an agreement with the government, there is a good chance that the technology will be developed separately and there will be no opportunity to incorporate defense requirements into its development or

[9] 50 U.S.C. App. 2401.

[10] The International Traffic in Arms Regulations are enforced by the Department of State under the Arms Export Control Act of 1976, 22 U.S.C. §2571.

obtain any government rights to the technology. Government access may then be limited, or the technology may be unusable from a defense standpoint.

Any restrictions placed on the transfer of technology will be difficult for most firms to accept. Remember that firms must maintain an edge in an ever-increasingly competitive and global marketplace. Therefore, firms are going to produce where it is most economical, and they are going to want the freedom to transfer their technology to third parties if that is in their best interest.

This is a tricky issue and one that should be addressed up front. Any restrictions on technology transfer must be addressed in the negotiations. It is important to convey the option that the government can waive its restrictions on technology transfer and the requirement of substantial manufacture in the United States. Such a waiver might be helpful, for example, for a firm that has made a reasonable but unsuccessful effort to transfer the technology under the terms that it is manufactured substantially in the United States, or for which domestic manufacture is not commercially feasible. At the same time, you need to keep the interests of DoD in mind. What is the potential sensitivity of the technology being developed? What are the risks of foreign manufacturing to the Department? What will be the impact on the domestic manufacturing base? These are some of the questions that need to be asked.

Cost Sharing

As discussed earlier, cost share by industry participants within the TRP was required by law to be at least 50 percent to the maximum extent practicable. The same requirement applied to the DU S&T Program and is still the level that you should strive to achieve. There will be exceptions, but as a general rule, industry cost-share should not go below 25 percent. The arguments for cost share in dual-use development are that (1) a commitment of funds demonstrates a commitment to success, and (2) funding should come from those who will ultimately benefit from the development. The government sees this type of cost-share arrangement as fair and reasonable.

Industry, on the other hand, is sometimes less enthusiastic about cost sharing with the government. However, industry representatives report that they are not opposed to the concept in situations offering potential business opportunities for the commercial participant. Indeed, cost sharing development arrangements are common between firms in the private sector.

It is important to be flexible and determine the proper level of cost share based on the following considerations:

- The amount of cost sharing is a good indicator of the level of commitment to the success of the project.
- Large firms may be more capable of cost sharing than small firms.

- Cost-share percentages should be based proportionately on expected benefits to the government and industry participants.

- Cost-share ratios should be influenced by the decisions of IP rights.

The quality of cost share is also important. Seek "high-quality" cost share to the maximum extent. High-quality cost share is cash that is spent for labor hours, materials, equipment, restocking parts, and material consumed. These financial resources are expended by the team based on the project's statement of work (SOW) and must be subject to the direction of the project management team. IR&D is a form of cash and should be considered high-quality cost share. Cost share phasing, which calls for a disproportionately early funding by the government with industry cost sharing inserted late in the program, should be considered on a case-by-case basis and should be generally avoided.

The following costs are unacceptable forms of industry cost share, since either they demonstrate no prospective risk, or including them as a part of cost share would be considered an inappropriate accounting treatment:

- Sunk costs, i.e., costs incurred without prior approval, before the start of the proposed project, to include the value claimed for IP or prior research;

- Foregone fees or profits;

- Foregone general and administrative or cost-of-money expenses, which would have been applied to a base of IR&D;

- Parallel research or investment, i.e., research or other investments that might be related to the proposed project but will not be part of the SOW or subject to the direction of your project management team; and

- Off-budget resources, i.e., resources that will not be risked by the proposer on the SOW and should not be considered when evaluating cost share.

Program Management

BENEFITS TO THE SERVICE PROGRAM MANAGER

As described in the introduction to this guide, dual-use S&T projects have great benefits to the government. In addition to those high-level benefits, there are benefits to you, the program manager. In fact, there are at least three reasons why you might want to employ the dual-use S&T process.

First, when commercial potential exists, it is an opportunity to cost share the development of technology with industry. Through cost sharing, you can increase the funding available to meet defense requirements. Second, you will learn a new technique for pursuing S&T that will be a valuable tool throughout your career. Those who are comfortable with this approach should find themselves in demand. Third, experience has shown that program managers frankly enjoy dual-use S&T projects. These projects typically focus much more on S&T and much less on administrative requirements. People who have worked on them say that the projects bring new challenges; allow managerial approaches that are not possible under conventional funding instruments; and provide a more exciting, focused, and fruitful environment for S&T development.

PRE-DUAL-USE SCIENCE AND TECHNOLOGY SOLICITATION

In order to maximize success, you must clearly understand the military needs associated with the technology as well as the potential commercial applications. Some steps you can take in that direction are as follows:

- Form an integrated product team (IPT) that includes representatives of the S&T community, the customer, and all those needed to establish the viability of a dual-use project. Its objectives should include identifying the customer, technology objectives, and tradeoffs.

> Understand military needs and pertinent segments of the commercial sector.

- Discuss the military and commercial market implications. During the discovery period, a candid exchange with the interested firm(s) (with customer participation) will help to resolve ambiguities concerning how well a commercially viable product may meet military needs.

- Establish performance metrics. Begin to identify the cost and performance goals that must be met if military utility and commercial success are to be realized.

DUAL-USE SCIENCE AND TECHNOLOGY SOLICITATION

Once it is clear that there is good potential for satisfying both military and commercial goals with one technology or product, you can cast a broader net through a BAA or program solicitation. The language and criteria used for a successful bid are key elements in establishing a viable transition strategy that will move the technology being developed into a weapon system and the commercial market as quickly as possible. Ask the question, if the technology is successfully developed what is the next step. The following steps are important:

- Define the military utility for each technology and product. The language used in soliciting ideas generally allows a good deal of flexibility, but considerations of military utility should be stated up front, with some degree of specificity whenever possible. If available, and depending on the maturity of the technology, make the performance and cost goals a part of the transition strategy.

- Issue a BAA or program solicitation. This type of solicitation calls for offerors' unique ideas to solve broadly-stated technical goals. Evaluation criteria and proposal instructions are important aspects of the solicitation. Criteria used in the Dual Use S&T Program include military benefit, amount and quality of cost share, commercial viability of technology, and technical and management approach, i.e., does the firm or consortium have the resources to develop and transition the technology to a military system(s) and the commercial marketplace?

CONDUCT OF PROJECT

Once the dual-use project has been awarded, focus on two main activities: performance monitoring and writing the transition plan. The key success factor in both activities is collaborative discussions with the members of the team, including the firm. These activities are discussed in the sections that follow.

Performance Monitoring

Monitor performance throughout the project. This includes the following responsibilities:

- Assess the process and apply performance metrics. Continuously assess performance against the metrics. Issue project progress reports and employ lessons learned from mistakes and successes to improve the project and processes. Update performance metrics as necessary.

- Continue to make tradeoffs as necessary. As the development project matures, tradeoffs may become necessary to ensure a commercial and military market.

- Maintain customer awareness. Keep the military customer in close contact throughout the project. This can be accomplished through project progress reports, assessment reports, and invitations to project reviews and demonstrations.

- Ensure military utility. Monitor product progress closely to ensure military utility.

Transition Plan

During the performance period of the dual-use project, the transition strategy, if possible, should be made into a transition plan, in cooperation with the participating firm(s) and the military customer(s). While much will depend on the maturity of the technology under development, the following should be established where possible:

- Characteristics of the product necessary to ensure military utility (including performance specifications and cost). Address the specified testing required, e.g., troop testing, acceptance criteria needed for transition.

  - Outline the path to military transition, e.g., who will test and buy the product or the development program the technology is supporting.

  - Outline a path to commercial success—include any conflicts with military utility.

  - Define transition milestones.

- During the development of the technology, it is important to revisit and further define the transition strategy and plan as needed.

- If the technology under development is not mature enough to develop a detailed transition plan you still have to know the Department's future plans for the technology before you initiate a dual-use project. And just like a transition plan, those plans need to be refined as the project proceeds and results of the research are made clear. Keep up with the development programs the technology will likely support and make plans for the transition of the technology into these programs.

- Circumstances that will demand revisiting and possibly refining the transition strategy and/or plans include: changes in the base technology, unanticipated failures or successes in development, changes in customer needs (military or commercial), and changes in the schedule for delivery.

Collaborative Discussions

Collaborative discussions are required during performance and should include both activities described above. The entire team should establish a process for continuous dialogue addressing the entire project, its evolving technology, and the potential ramifications to products in both the military and commercial marketplace.

PROJECT COMPLETION

By the end of the project, the transition strategy and plan should have paved the way for a smooth introduction of the technology into defense products or a development program. User testing, where appropriate, should have been agreed upon. It is important to document and provide potential military customers and/or development programs with any test data generated during the execution of the project to help in the transition of the technology.

New Instruments Are Available to Facilitate Dual-Use Science and Technology Development

As the program manager, be aware that there are new funding instruments available to the agreements officer that make it easier to accomplish dual use technology development with industry. These new instruments provide flexibility for negotiation in areas such as intellectual property, cost accounting, and auditing that are often cited as barriers to a commercial firm's acceptance of traditional government funding requirements. The types of funding instruments available to agreements officers depend on the principal type of relationship that DoD will have with the research performer carrying out the dual use project.

Acquisition

If the principal purpose in entering into the relationship is to acquire goods or services for the benefit of the government, then the relationship will be an "acquisition" relationship. Acquisition relationships are "buyer/seller" relationships, and we appropriately think in terms of "price" for whatever deliverables the performer is to provide. The traditional instruments for acquisition relationships are procurement contracts under the Federal Acquisition Regulation (FAR). However, agreements officers can now also use "Other Transactions" (OTs) for Prototypes. The Under Secretary of Acquisition, Technology, and Logistics has issued guidance for the use of those OTs for Prototypes that provides more flexibility to negotiate award provisions in key areas than is possible for traditional procurement contracts under the FAR. This guidance can be found on the DU S&T web page (www.dtic.mil/dust).

Assistance

A different set of instructions is available when our principal purpose in entering into a relationship with the research performer is to stimulate or support technology development, rather than to acquire goods or research services. In the parlance of Federal statutes and rules related to funding instruments, this is an "assistance" relationship, rather than a "acquisition" relationship. You might think of this as an arrangement where we choose to invest in a performer's technology development effort, one they wish to carry out for their own purposes. We might do that, for example, because we see a good potential for the technology to also meet DoD's needs and think that our participation as an investor will enhance that potential (e.g., by ensuring that the technology addresses defense-unique issues or by accelerating its development in time for critical decision points on future defense systems).

Traditional assistance instruments include grants and cooperative agreements. Using the "Other Transaction" authority in 10 U.S.C. 2358, DoD has developed a new class of assistance instruments called Technology Investment Agreements

(TIAs). The Director of Defense Research and Engineering issued interim guidance for TIAs and plans to issue coverage for TIAs in a new part of the DoD Grant and Agreement Regulations. Both interim guidance and the draft part of the DoD Grants and Agreement Regulations give agreements officers more flexibility to negotiate award provisions than they had previously for assistance instruments.

Conclusion

As stated earlier, the goal of the DoD's S&T program is to provide the best technology available to our warfighter. In the past we met this challenge by calling on a host of in-house laboratory capabilities, as well as a defense industry that is familiar and willing to work with the military. The future will require more. We will have to actively engage commercial industry to gain access, in many cases, to the best technology to meet our defense needs. The dual-use process described in this guide can overcome the cultural obstacles, form effective partnerships with industry and gain increased access to the commercial technologies needed to meet future defense requirements.

Appendix A
Success Stories

The following dual-use S&T success stories provide insight into the successes of TIAs in dual-use projects. The Army, Navy, and Air Force are all represented in these stories.

DEVELOPMENT OF NEW PRODUCT TECHNOLOGIES BASED ON MAGNETORHEOLOGICAL FINISHING

The Army needed a way to economically finish and polish nonconventional (i.e., aspheric and conformal) optics. Such a capability would have a significant impact on the effectiveness and affordability of future optical and electro-optical systems for missile systems, man-portable and small arms systems, helicopters, unmanned airborne vehicles, and space-based electro-optical systems. The technology would also enable the economical manufacture of "high-end" precision optics components used in applications in commercial telecommunications (high-definition television and laser lithography), medicine (surgical lasers and imaging systems), and information technology (optical data storage and laser printers).

The dominance of the commercial marketplace in optical technologies led the Army to consider implementing a cooperative dual-use S&T development project to meet the government's need. QED Technologies, a small business, was selected as the commercial partner. The project was executed through a TIA that allowed QED to retain the IP rights to the resulting technology.

The technology developed has, according to the government program office, exceeded expectations by ten-fold. It provides both the military and commercial production bases with capabilities that did not previously exist, i.e., the ability to perform deterministic optical finishing of visible and infrared optical flats, spheres, aspheres, and highly complex shapes, such as off-axis aspheres and conformal windows. This technology can, for example, improve the figure of a 1/3-wave lens to 1/20-wave in five minutes instead of requiring two days of manual finishing. It can produce a 1/100-wave lens in fifteen minutes instead of requiring weeks of hand correction. The technology also can finish aspheric lenses in minutes. The result is an estimated 30 percent reduction in the cost of high-quality lenses and a 50 percent reduction in the cost of prototype lenses. QED Technologies already has sold twelve Q22 machines incorporating the magnetorheological finishing technology to private industry.

Total Dollar Value: $2,140,988

Industry Cost Share: $1,070,494

COMMERCIAL ACTIVE BRAKING SYSTEMS FOR MEDIUM-DUTY WHEELED VEHICLES

The Army wanted to enhance the capabilities of its medium-sized wheeled vehicles by including an electronically-controlled active braking system (ABS) and low-speed traction control capability in its ground vehicles, especially the High Mobility Multipurpose Wheeled Vehicle (HMMWV). An ABS would provide much better performance and would greatly improve the safety of the HMMWV. However, a unique ABS and traction control development program just for the military was viewed as cost prohibitive. The Tank Automotive Command's National Automotive Center (NAC) explored commercial alternatives, and included its requirements in a BAA. Several potential partners, including ITT Automotive Systems (later purchased by Continental Teves), were identified. Engineers at ITT Automotive's Brake Group, a global leader and supplier of active braking systems to the commercial market, were interested in upgrading the ABS and traction control currently used on commercial sport utility vehicles for use on larger commercial trucks. However, their proposed commercial development had not received corporate approval in the corporate competition for R&D funding. However, the cost-share project with the Army did receive corporate support.

The brake group had no previous experience in contracting with the DoD. A TIA was essential for them to participate. The agreement provided that commercial accounting rules were acceptable and IP rights, except for government march-in rights,[11] were retained by the corporation.

The project has been very successful, both commercially and militarily. A commercial braking unit was developed that incorporated the requirements of the HMMWV. On the defense side, the project involved developing and integrating the MK50 ABS with low-speed traction control on a M1097A2 HMMWV. The product fully met the military's technical objectives and Continental Teves has been selected as the brake supplier for the next generation HMMVW, the A4. The brake units for the A4 will be produced on a commercial production line. The expected acquisition cost for the A4 units is $500 to $700 per unit, compared to approximately $2,500 per unit without the commercial production base. These savings are expected to result in over $50 million in reduced A4 acquisition costs. On the commercial side, Continental Teves has received orders for the technology and expects to sell 70,000 units per year, starting this year (2002).

This project won the First Annual Dual-Use Science and Technology (DUS&T) Achievement Award in November 2000. The award recognizes successful dual-use projects and honors those individuals in the military departments responsible for their initiation and execution.

[11] Government march-in rights are a compulsory license of a firm's technology to another entity, but only if the original firm fails to commercialize the specific technology.

Total Dollar Value: $2,950,000

Industry Cost Share: $2,000,000

FREEFORM MANUFACTURING OF SPARES USING LASERFORMING

The Navy needs the capability to economically produce small numbers of new and "hard-to-get" parts for both aircraft and ships. Because this is an issue for commercial aircraft firms as well as for the military, Naval Air Systems Command considered a cooperative dual-use development approach. The Navy PM sponsoring this project has had experience with cooperative S&T development and likes the cost sharing aspects. He believes that cost-sharing demonstrates an industry commitment to developing a product and that the probability of transition to a useful military product is much better with such a commitment than with a standard R&D funding instrument.

This particular project was designed to demonstrate Laserforming (a process that uses 3-D graphical models to build up parts in layers from metal powders that are melted and fully consolidated with a laser) as a viable freeform method for low-cost production of new and "hard-to-get" titanium spare parts. The Navy advertised the proposed work and received several proposals. A team composed of the McDonnell Douglas Corporation (subsequently Boeing Company), AeroMet Corporation, and Virginia Polytechnic Institute and State University was selected, and a TIA was negotiated. The two-year project has been successful in demonstrating the cost benefits of this technology for fabricating structural components for aircraft and ship application. For example, it is estimated that the technology will reduce material usage by two-thirds, reduce component delivery time by 75 percent, and reduce costs by 20 percent for titanium aerospace structural components. The technology has transitioned into a Navy cost reduction program for four components on the F/A-18 E/F aircraft. If fully implemented on 400 aircraft, expected savings will be $50 million.

Total Dollar Value: $518,734

Industry Cost Share: $290,878

MS1: RENEWAL OF LEGACY SOFTWARE SYSTEMS

This Navy project grew out of the need to address the high cost of upgrading military aviation software. The Navy desired the abilities to continue to use proven legacy software when upgrading the system capability and improving processor performance, reuse software between platforms/services, and hold down costs associated with rewriting/debugging. These were challenging goals, but similar goals exist in commercial aviation, where aircraft have long service lives and new capabilities must be accommodated. With this in mind, Naval Air

Systems Command (NAVAIR) decided to consider a cooperative dual-use S&T development approach with commercial aviation. Cooperative development would allow NAVAIR to leverage limited R&D funds. During a search for potential partners, NAVAIR identified CPU Tech, a small commercial firm with expertise in embedded microprocessor developments. The firm was already the recipient of a Small Business Innovative Research (SBIR) contract and thus had some experience working with the DoD. CPU Tech was interested. The technical objectives were agreed upon, but the contract negotiations were very difficult. Principal issues were rights in technical data and government CAS. As a small technology firm, CPU Tech is highly dependent for its survival on the technology that it has developed over the past decade. It also had limited capability to meet government cost accounting requirements. It refused to allow DCAA involvement, so a certified public accountant firm has monitored the contract. The Navy used a TIA to allow it to meet some of the contractor's concerns. After a lengthy negotiation, an agreement was executed. CPU Tech retained all IP rights except for government "march-in rights." In their evaluation of the agreement process, both sides cited a need for more understanding of non-FAR instruments.

However, the project has been highly successful in developing a verifiable hardware emulator that can execute legacy software in real-time. The processor is now being used as a part of the Air Force F-16 upgrade program on the fire control radar, with projected savings of $150 million. Savings from other applications of the technology are estimated at as high as $1 billion over the next decade. Technology applications are being marketed for other military avionics as well as commercial avionics, communications satellites, radar systems, and navigation and guidance systems. The project was selected as first runner-up for the First Annual DUS&T Achievement Award in November 2000.

Total Dollar Value: $4,600,346

Industry Cost Share: $2,300,173

FUTURE AIR NAVIGATION & TRAFFIC AVOIDANCE SOLUTION THROUGH INTEGRATED CNS (FANTASTIC)

The world's air traffic control (ATC) systems are being modernized to accommodate a four-fold increase in traffic and to replace voice commands with digital data for increased safety and reliability in a multi-lingual pilot community. All aircraft—including United States Air Force platforms—must comply while traversing civilian controlled airspace or face altitude restrictions or rerouting. For large-body aircraft, commercial gear could be ported aboard, but for fighter aircraft, size, weight, and power restrictions precluded such a remedy. FANTASTIC was created—as a dual-use program—to solve this Global Air Traffic Management (GATM) problem for fighter aircraft and, also, for general aviation aircraft

(business and personal), which faced similar problems and were more sensitive to the added cost of a system to meet the new requirements.

The project was executed as a TIA even though it was with a defense firm. This instrument was very beneficial because it provided streamlined reporting and data requirements (thus giving more performance bang for the buck), as well as the flexibility to pursue targets of opportunity during execution, thereby fine-tuning the product to the evolving environment.

Funding disruptions at several points did cause the program schedule to slip by about six months, but the overall program finished under budget and has been very successful. A final demonstration showed that many of the new ATC requirements could be met within an extremely small package (4”x6”x3”), which was also programmed to perform two existing communications waveforms—Have Quick and SINCGARS—to demonstrate flexibility. The technology is planned for transition to the Joint Tactical Radio System, which is the expected transition path to the existing fleet. In addition, hardware and software products from FANTASTIC have been or are planned for direct transition to both commercial and DoD programs. The low-cost receiver from FANTASTIC is planned as a replacement for the current F-22 receiver at a savings to the government of more than $100M, and similar savings are expected in the Army Comanche helicopter and the Joint Tactical Fighter programs. Software has already been transitioned to two of Collins’ commercial aircraft radios and their military ARC-210 radio, and is being transitioned to the C-135 fleet as part of the GATM upgrade. The success of FANTASTIC was celebrated by its selection as second runner-up for the first annual Office of the Secretary of Defense Dual-Use Technology Award.

Total Dollar Value: $10,188,951

Industry Cost Share: $5,100,000

COLLABORATIVE ENGINEERING AND VIRTUAL PROTOTYPING

The Air Force is interested in acquiring engineering instruments and techniques that will reduce the cost of systems development, improve the quality of design, and result in faster time to a deployed product. In 1997, the Air Force joined with a team of firms from the private sector in an effort to apply modern computer-based engineering and information technologies to solve complex research and system acquisition problems. The Collaborative Engineering and Virtual Prototyping Project was designed to allow geographically separated teams of government and industry engineers, scientists, managers, and procurement specialists to work together to jointly develop advanced technology products. Using the collaboration framework, a development team will be able to access computer-based engineering instruments, models and simulations, databases, and research facilities worldwide. The dual-use S&T project team selected by the Air Force was led

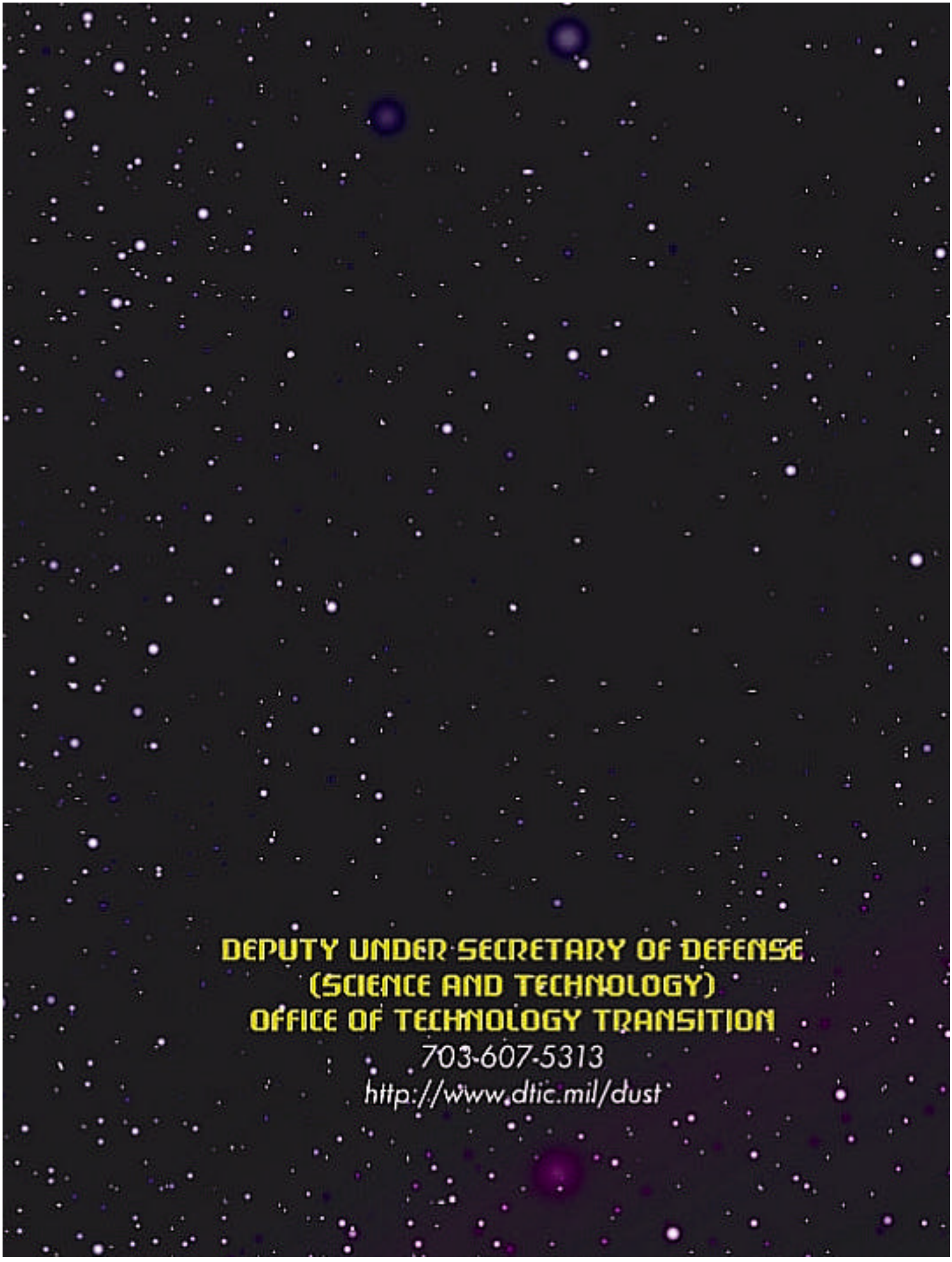
by Ball Aerospace & Technologies Corporation. and consisted of firms with both defense and commercial aerospace experience, including Lockheed Martin Missile & Space Corporation, Science Applications International Corporation, and Parametric Technologies Corporation.

The Air Force used a TIA for the project. This was viewed as very helpful. The agreement was negotiated faster than a normal FAR contract and was seen as more flexible. For example, under the cooperative agreement the developing recipient retained rights to individual component technologies, with the Air Force having restricted use rights. Moreover, the government PM reported "with industry cost sharing and the goal of developing a new commercial market, development [proceeded] along a faster track to delivering a product with greater leveraging of commercial technology."

The project fully met its technical objectives. A live experiment was conducted in the fall of 1999 involving four Air Force laboratories and three recipient facilities. The experiment demonstrated the capabilities of collaborative engineering involving multiple technology domains across four geographical locations. A subsequent experiment in the fall of 2000 further demonstrated the utility of the technology. In September 2000, Ball Aerospace & Technologies released KnowledgeKinetics (K2) version 1, a commercial collaborative-environment product based on the dual-use research effort. K2 version 2 was expected in May 2001, and version 3 in December 2001. Speaking of the new product at the time of its September 2000 release, the government PM stated, "The Collaborative Engineering Environment (CEE) research implemented in K2 will facilitate collaborative virtual operations and effect a major cultural change in how business is conducted in the defense and commercial sectors."

Total Dollar Value: $3,983,736

Industry Cost Share: $1,989,848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